

7

Science Standard
7.3.e.



Responding to Environmental Change

California Education and the Environment Initiative

Approved by the California State Board of Education, 2010

The Education and the Environment Curriculum is a cooperative endeavor of the following entities:

California Environmental Protection Agency
California Natural Resources Agency
Office of the Secretary of Education
California State Board of Education
California Department of Education
California Integrated Waste Management Board

Key Leadership for the Education and Environment Initiative:

Linda Adams, Secretary, California Environmental Protection Agency
Patty Zwarts, Deputy Secretary for Policy and Legislation, California Environmental Protection Agency
Andrea Lewis, Assistant Secretary for Education and Quality Programs, California Environmental Protection Agency
Mark Leary, Executive Director, California Integrated Waste Management Board
Mindy Fox, Director, Office of Education and the Environment, California Integrated Waste Management Board

Key Partners:

Special thanks to **Heal the Bay**, sponsor of the EEI law, for their partnership and participation in reviewing portions of the EEI curriculum.

Valuable assistance with maps, photos, videos and design was provided by the **National Geographic Society** under a contract with the State of California.

Office of Education and the Environment

1001 I Street • Sacramento, California 95812 • (916) 341-6769

<http://www.calepa.ca.gov/Education/EEI/>

© Copyright 2010 by the State of California
All rights reserved.

This publication, or parts thereof, may not be used or reproduced without permission from the
Office of Education and the Environment.

These materials may be reproduced by teachers for educational purposes.



Lesson 1 Adapting to Environmental Change

None required for this unit.

Lesson 2 What Causes Extinctions?

None required for this unit.

Lesson 3 Human Population Growth and Extinction

None required for this unit.

Lesson 4 Natural Resources and Extinction

None required for this unit.

Lesson 5 Human-Caused Change in Ecosystems

Coastal Dunes Game Cards 3
High Desert Game Cards 7
Kelp Forest Game Cards 11

Lesson 6 When Species Cannot Adapt: A Discussion

None required for this unit.

Assessments

Responding to Environmental Change—Traditional Unit 15
Assessment Master
Interview with a Park Ranger—Alternative Unit 20
Assessment Master



Coastal Dunes Game Cards

Lesson 5 | front of page 1 of 2

	Scissors	Scissors	Scissors
Scissors	<div>Coastal Dunes How does European beachgrass affect the population of the snowy plover? a. It reduces the population. b. It causes the population to grow. <i>Answer: a. The plover nests in open spaces. European beachgrass reduces the population of the snowy plover because it covers up the dunes. By covering the dunes, the grass makes it hard for the plover to see predators and eliminates the plover's nesting habitat.</i></div>	<div>Coastal Dunes How does European beachgrass affect the structure of the dunes? a. It helps the dunes grow by holding down the sand so it does not blow away. b. It prevents wind from moving the sand, which is needed to build and support the back dunes. <i>Answer: b. The movement of sand is an important natural process of the ecosystem.</i></div>	
Scissors	<div>Coastal Dunes How does building a dam on a nearby river affect the structure of coastal dunes? a. It prevents the dunes from eroding and preserves the ecosystem. b. It causes the dunes to erode (or wash or blow away) over time. <i>Answer: b. Dunes naturally erode and rebuild. Sand brought by rivers is important for the rebuilding part of this cycle. Without the action of the rivers, dunes cannot rebuild.</i></div>	<div>Coastal Dunes Is the following statement true or false? Storms destroy the coastal dune ecosystem because the wind and waves erode the dunes. <i>Answer: False. Part of the natural cycle of dunes is erosion from winter storms. Sand is returned to dunes during calm summers. A healthy dune system is not destroyed by storms, though they cause some erosion.</i></div>	
Scissors			



Coastal Dunes Game Cards

Lesson 5 | front of page 2 of 2

<div data-bbox="316 235 349 283" data-label="Image"></div> <div data-bbox="235 315 284 346" data-label="Image"></div> <p>Coastal Dunes</p> <p>What happens to dunes if native plants are removed?</p> <p><i>Answer: Roots of native plants loosely hold the sand in the dunes, allowing it to blow to the back dunes for rebuilding. Without the native plants, the sand could blow away and the dunes could be destroyed.</i></p>	<div data-bbox="795 235 828 283" data-label="Image"></div> <div data-bbox="1274 235 1307 283" data-label="Image"></div> <p>Coastal Dunes</p> <p>Do hiking, horseback riding, or driving on sand affect the dunes?</p> <p><i>Answer: Yes. Disturbing roots or destroying plants with these activities results in loss of the coastal dunes.</i></p>
<div data-bbox="235 987 284 1018" data-label="Image"></div> <p>Coastal Dunes</p> <p>In some coastal dune areas, people are removing European beachgrass that was planted in the 1930s. How will the removal affect the snowy plover?</p> <p>a. It will help the population to grow.</p> <p>b. It will reduce the population.</p> <p><i>Answer: a. Removal of this plant will help the snowy plover's population to grow because it will provide more open spaces for nests and allow the plover to see and avoid predators.</i></p>	<div data-bbox="1274 987 1307 1018" data-label="Image"></div> <p>Coastal Dunes</p> <p>In some areas, people are removing European beachgrass planted in the 1930s. How will the removal affect the ecosystem?</p> <p>a. The dunes will blow away without the roots of the grass.</p> <p>b. It will allow sand to blow to the back dunes and help restore the ecosystem.</p> <p><i>Answer: b. Blowing sand builds and maintains dune ecosystems. European beachgrass forms a dense mat and prevents sand from rebuilding dunes.</i></p>



High Desert Game Cards

Lesson 5 | front of page 1 of 2

<p>✂</p> <p>High Desert</p> <p>What would happen if people removed the nonnative tamarisk tree from the high desert? How would endangered fish populations change?</p> <p>a. Fish populations would increase.</p> <p>b. Fish populations would decrease.</p> <p><i>Answer: a. Tamarisk trees use large amounts of water, often drying up water sources. Fish populations would increase if water supplies became more available.</i></p>	<p>✂</p> <p>High Desert</p> <p>Which of these desert features change when humans drive off-road vehicles there? Select all that apply.</p> <p>a. Population of desert tortoises goes down.</p> <p>b. Population of ravens goes up.</p> <p>c. Population of desert plants goes down.</p> <p>d. Water seeps into the desert soil.</p> <p><i>Answer: a and c. Off-road vehicles can crush tortoise burrows and animals. They compact soil and damage plants.</i></p>
<p>✂</p> <p>High Desert</p> <p>What happens to ravens when humans put open landfills in the desert? What happens to desert tortoises when humans put open landfills in the desert?</p> <p><i>Answer: The number of ravens goes up because ravens eat the food found in the landfills. The number of tortoises goes down because ravens eat baby tortoises.</i></p>	<p>✂</p> <p>High Desert</p> <p>People have planted tamarisk trees in the high desert. How has this practice changed the populations of willow and cottonwood trees?</p> <p><i>Answer: The populations of cottonwoods and willows have gone down. The tamarisk trees outcompete the native trees for water.</i></p>

High Desert Game Cards

Lesson 5 | back of page 1 of 2



High Desert Game Cards

Lesson 5 | front of page 2 of 2

<p>✂</p> <p>High Desert</p> <p>Humans have built dams that prevent seasonal flooding in the desert. How does dam building affect populations of willow and cottonwood trees?</p> <p><i>Answer: Their populations go down. They rely on seasonal flooding to survive.</i></p>	<p>✂</p> <p>High Desert</p> <p>As more humans move to the desert they pump more water out of the ground. How does this pumping affect endangered fish species?</p> <p><i>Answer: Fish populations go down because the water supply goes down. Less water also means that the temperature of the water increases. The fish cannot survive the higher temperatures.</i></p>
<p>✂</p> <p>High Desert</p> <p>If a person throws a piece of trash away in the desert, why will it take a long time to decay?</p> <p><i>Answer: The desert is dry (water is required for decay) and few decomposers live there.</i></p>	<p>✂</p> <p>High Desert</p> <p>Which of these species decreases when humans build roads? Select all that apply.</p> <p>a. ravens b. desert tortoises c. tamarisk trees</p> <p><i>Answer: b. Building roads causes populations of desert tortoises to decrease. These animals get killed when they try to cross from one side of a road to the other.</i></p>

High Desert Game Cards

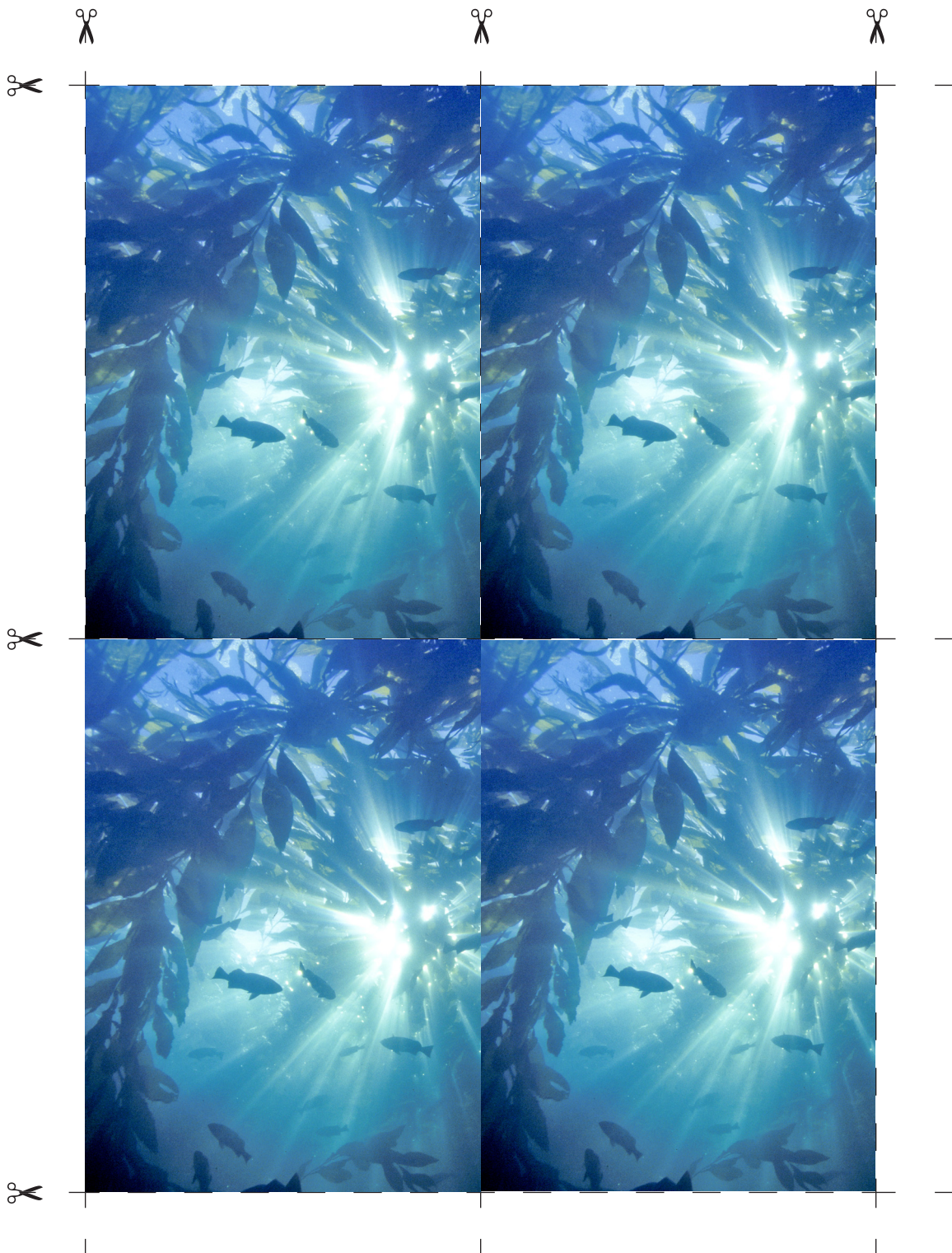
Lesson 5 | *back of page 2 of 2*



<p>✂</p> <p>Kelp Forest</p> <p>How does a decline in the population of sea otters affect sea urchins?</p> <p>a. The population of sea urchins increases.</p> <p>b. The population of sea urchins decreases.</p> <p><i>Answer: a. The population of sea urchins increases. Otters hunt sea urchins; without otters, more sea urchins survive.</i></p>	<p>✂</p> <p>Kelp Forest</p> <p>When oil tankers spill oil into the ocean, oiled otters often die of hypothermia (low body heat). How does this affect the kelp forest?</p> <p>a. The population of kelp increases.</p> <p>b. The population of kelp decreases.</p> <p><i>Answer: b. The population of kelp goes down. Otters hunt sea urchins, which graze on kelp. With few otters, the sea urchins consume the kelp.</i></p>
<p>✂</p> <p>Kelp Forest</p> <p>Sea otters often get caught and drown in fishing nets. People have banned the use of these nets in some areas where sea otters live. How could this ban affect the kelp forest?</p> <p>a. The population of kelp increases.</p> <p>b. The population of kelp decreases.</p> <p><i>Answer: a. The population of kelp goes up. Otters hunt sea urchins, which graze on kelp. When there are more otters, the sea urchin population goes down, and more kelp can grow.</i></p>	<p>✂</p> <p>Kelp Forest</p> <p>How does overfishing of rockfish affect the kelp forest?</p> <p>a. The population of kelp increases.</p> <p>b. The population of kelp decreases.</p> <p><i>Answer: b. The population of kelp goes down. Young rockfish eat the barnacles and snails that eat the kelp. Reducing the rockfish population increases the numbers of barnacles and snails, thus reducing the kelp population.</i></p>

Kelp Forest Game Cards

Lesson 5 | *back of page 1 of 2*



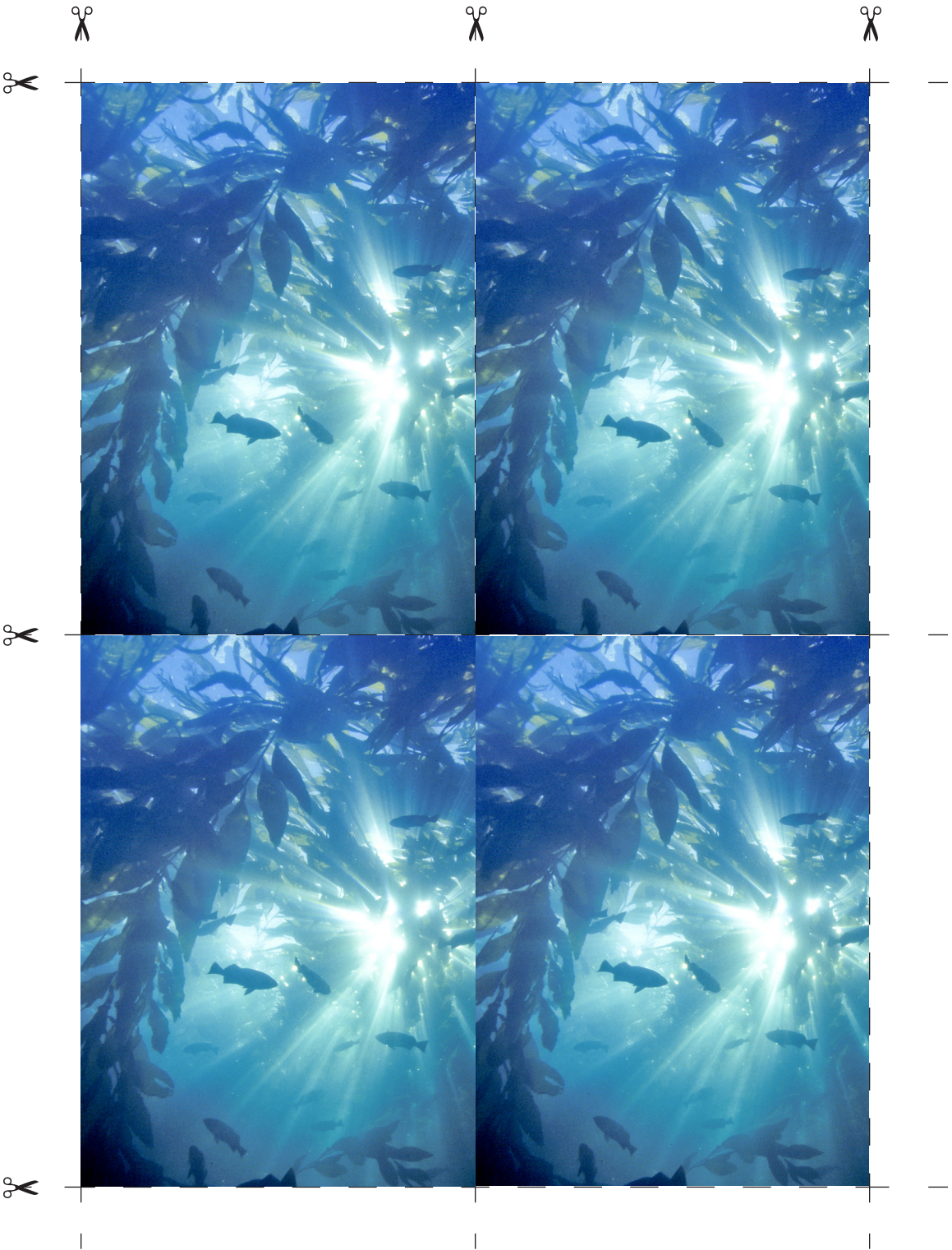
Kelp Forest Game Cards

Lesson 5 | front of page 2 of 2

<p>✂</p> <p>Kelp Forest</p> <p>If the population of kelp goes down, what other populations go down? Select all that apply.</p> <ul style="list-style-type: none"> a. sea urchins b. gray whales c. rockfish d. sea otters <p><i>Answer: a, b, c, and d. During their long annual migration, gray whales feed in kelp forests and use them to hide from orcas. Rockfish and sea otters both find food and shelter in the kelp forest. Sea urchin populations could go down if they cannot find food sources to replace the kelp they eat.</i></p>	<p>✂</p> <p>Kelp Forest</p> <p>Is the following statement true or false?</p> <p>The kelp forest ecosystem can keep functioning with moderate amounts of kelp harvesting since only the top portions of the kelp are removed.</p> <p><i>Answer: True. Kelp grows rapidly, so moderate amounts can be removed and the ecosystem can still adapt.</i></p>
<p>✂</p> <p>Kelp Forest</p> <p>Is the following statement true or false?</p> <p>Some storms rip kelp from the sea floor. This action severely damages healthy kelp forests ecosystems so they cannot grow back.</p> <p><i>Answer: False. A healthy kelp forest grows so quickly that it can grow back even after moderate storms. Some removal of kelp by storms is part of the natural cycle of the kelp forest ecosystem.</i></p>	<p>✂</p> <p>Kelp Forest</p> <p>Is the following statement true or false?</p> <p>Kelp forests can be weakened by the excessive grazing of sea urchins. If the kelp forest is not healthy, it may not easily recover from the damaging effects of a moderate storm.</p> <p><i>Answer: True. Storms rip kelp from the sea floor. An unhealthy kelp forest may not be able to fully recover following a moderate storm.</i></p>

Kelp Forest Game Cards

Lesson 5 | back of page 2 of 2



Name: _____

Part 1**Instructions:** Select the best answer and circle the correct letter. (2 points each)

1. Which of the following is an example of an adaptation?
 - a. Shorebirds have long beaks that are well-structured to dig up food from the sand.
 - b. Coyotes start hunting in packs when wolves are introduced to their ecosystem.
 - c. Peregrine falcons start nesting on bridges and buildings instead of cliffs.
 - d. Bears choose to eat trash when it is available.

2. Which of the following is an example of an adaptive characteristic?
 - a. Coral can only survive in a small temperature range.
 - b. Opossums can eat many different kinds of foods.
 - c. Western snowy plovers nest in open spaces on dunes.
 - d. Willows and cottonwoods grow in areas of the desert with seasonal flooding.

3. When an ecosystem changes, species with adaptive characteristics _____.
 - a. are more likely to survive because they evolve faster
 - b. are less likely to survive because they have specific habitat requirements
 - c. are more likely to survive because they can live in a wide range of habitats
 - d. are more likely to become extinct because changes in ecosystems put species at risk of extinction

4. Which of the following changes in an ecosystem may put a species at risk of extinction?
 - a. removing the predator of that species from the ecosystem
 - b. adding a nonnative species that competes for the same resources
 - c. removing the species' prey from the ecosystem
 - d. b and c
 - e. All of the above.

5. Extinction has occurred _____.
 - a. only in the distant past
 - b. only in modern times
 - c. throughout the history of life on Earth
 - d. only among animal species

Responding to Environmental Change

Traditional Unit Assessment Master | page 2 of 5

Name: _____

6. Which of the following have caused extinctions in the past?
 - a. hunting
 - b. climate change
 - c. habitat destruction
 - d. All of the above.

7. How has the human population changed over the past 400 years?
 - a. It has remained stable.
 - b. It has steadily increased.
 - c. It increased slightly initially, but in the last 100 years has increased much more rapidly.
 - d. It has decreased.

8. What is the biggest change to San Joaquin Valley ecosystems caused by humans in the past 150 years?
 - a. Most of the land has been converted to farms.
 - b. Most of the land has been converted to industry.
 - c. Most ecosystems look the same as they did before humans arrived.
 - d. Most of the land has been logged for timber.

9. How has human population growth affected species in California?
 - a. Most species have increased in population.
 - b. Some species have increased in population, while others have decreased.
 - c. Most species are now endangered.
 - d. Thousands of species in California have become extinct in the past 100 years.

10. Burning coal and oil for fuel and energy releases carbon dioxide in the air. This activity may cause _____.
 - a. acid rain
 - b. global climate change
 - c. water pollution
 - d. a and b

Name: _____

Part 2

Instructions: Read the following description of the high desert and then answer the following questions about changes in this ecosystem and their effects on different species. (2 points each)

The desert tortoise is a threatened species that lives in the high desert. It digs an underground burrow to keep away from the heat. It travels slowly through large areas to find food and water to survive. The tortoise has difficulty crossing roads safely because it travels slowly, so tortoises are sometimes killed by cars. When people drive off-highway vehicles through the desert they can crush tortoise burrows and sometimes the tortoises themselves. The raven is a newer arrival to the desert that is able to survive there because it eats the garbage left by humans. Ravens are attracted to the landfills and sewage plants people have built in the desert. However, in addition to human garbage, ravens also eat baby desert tortoises, contributing to the decline of this species. It is able to find and eat tortoises

more easily because humans have built tall power line poles that the ravens use as perch sites for spotting food below.

Some areas of the high desert contain small amounts of water. Rare pools house fish, most of which are at risk of extinction because when the amount of water in these pools drops, the water becomes too hot for the fish. Trees, such as native cottonwoods and willows, live near water sources. Occasional desert floods help the cottonwoods and willows survive by clearing the soil and spreading seeds that can grow in the damp ground left by the flood waters. Humans have built dams that capture water upstream and reduce flooding in the desert. Cottonwoods and willows cannot survive when the soil gets dry.

11. When humans build open landfills in the desert, how does this affect the population of different species?
 - a. All species decrease in population.
 - b. Ravens increase in population.
 - c. Ravens increase in population and desert tortoises increase in population.
 - d. All species increase in population.

12. When humans build dams to control flooding and use water that used to flow through the desert, which species' populations decrease?
 - a. cottonwoods
 - b. fish
 - c. ravens
 - d. a and b

Responding to Environmental Change

Traditional Unit Assessment Master | page 4 of 5

Name: _____

13. When humans build roads with large power lines along them, how does this affect different species' populations?
- a. All species decrease in population.
 - b. Ravens increase and desert tortoises decrease.
 - c. Ravens decrease and desert tortoises increase.
 - d. All species increase in population.
14. When humans drive off-road vehicles over the desert, these vehicles crush the soil, making it hard for desert plants to take root there. Why does it take so long for the desert ecosystem to adjust to this kind of change?
- a. The desert is very humid.
 - b. The desert gets cold at night.
 - c. The desert is dry and the growth rate of plants is very slow.
 - d. Desert plants grow quickly.
15. Changes in ecosystems _____.
- a. happen only when humans enter ecosystems
 - b. happen constantly
 - c. occur rarely
 - d. cause the systems to stop functioning
16. Changes in ecosystems _____.
- a. put all species at risk of extinction
 - b. put species with adaptive characteristics at risk of extinction
 - c. put species without adaptive characteristics at risk of extinction
 - d. always increase populations of species

Part 3

Instructions: Use what you have learned about ecosystems and environmental change to answer the following questions in the space provided.

17. Identify two species with adaptive characteristics whose populations are increasing due to human activities.

18. Identify an example of a natural cause of extinction.

Name: _____

19. Identify an example of a human-related cause of extinction.

Part 4

Instructions: Select one the following California endangered species: salt marsh harvest mouse or California least tern. Answer the following questions in the spaces provided. (8 points total)

20. **Species:** _____

a. Where does it live?

b. What type of environment does it need?

c. What human-caused changes are affecting its survival?

d. Is it possible that this species could become extinct? How?

Name: _____

Interview with a Park Ranger

Instructions: In this unit, you have learned about environmental change and how change can lead to extinction for some species. In this assessment, you will demonstrate what you have learned by creating a mock interview with a park ranger at the imaginary High Desert State Park in California.

1. Pretend you are a radio news reporter. You will be interviewing a park ranger in California about the ecosystem in which the ranger works and the species that live there. Write a script of your radio interview. Write both the questions a reporter would ask and the answers the park ranger would give.
2. Your park ranger should be able to answer all of these questions:
 - What is this ecosystem?
 - What kinds of species live here?
 - What is an example of an adaptation of one of the species that live here?
 - What is the definition of adaptation?
 - What is an example of an adaptive characteristic in one of the species?
 - What is the definition of an adaptive characteristic?
 - What species are at risk of extinction?
 - What has caused this risk of extinction?
 - What is the definition of extinction?
 - What are other possible causes of extinction?
 - How do growing populations influence extinction in this ecosystem?
 - How do human activities and resource use influence extinction in this ecosystem?
 - What is special about this ecosystem that affects the way it adjusts to changes humans have made?
 - What happens when a species cannot respond to change in an ecosystem?

Interview with a Park Ranger

Name: _____

3. Include the following words in the interview in a way that shows that you understand what these words mean. This step will help you demonstrate that you understand the concepts covered in this unit.
- | | | |
|---------------------------|--------------|-----------|
| ■ adaptation | ■ ecosystem | ■ human |
| ■ adaptive characteristic | ■ extinction | ■ natural |
| | ■ endangered | |
4. You may use any resources that have been used during this unit, including the **High Desert Background** from Lesson 5.
5. Use the following **Interview with a Park Ranger Scoring Tool** as a guide as you write the mock interview and responses. Your teacher will use the “Interview with a Park Ranger Scoring Tool” to assess your mock interview.

Interview with a Park Ranger Scoring Tool

The interview and responses provide:	Many Details 4 points	Some Details 3 points	Few Details 2 points	No Details 1 point
Defines adaptation and gives at least one example.				
Defines adaptive characteristic and gives at least one example. Explains that individuals with adaptive characteristics can respond to environmental change.				
Gives examples of changes in the environment and explains how those changes affect at least one species.				
Defines extinction and explains that extinction occurs in response to environmental change.				
Describes natural factors that contribute to extinction.				
Describes how human actions can contribute to extinction.				
Describes how growing human populations change ecosystems.				
Explains how human activity and resource acquisition and use can change ecosystems.				
Explains how the way an ecosystem works or how healthy it is can influence how it responds to change.				
Explains how species that do not have adaptive characteristics and have not developed new adaptations may be at risk of extinction.				



California STATE BOARD OF
EDUCATION

California Education and the Environment Initiative

